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ABSTRACT

An experiment was undertaken with young children to look at the relative contribution of discourse constraints, subject anaphors, and the semantics of verbs to the integration of an utterance into its discourse representation. Children aged 5, 7, and 10 years heard a series of short stories, each consisting of three sentences and an incomplete fragment which the children had to continue with a few words indicating which of two story protagonists was being referred to. It was found that: (1) thematic subject constraint is not as dominant for the youngest children (5 and 7 years) as was expected based on earlier research; and (2) concerning the importance of evaluating protagonists with respect to the pragmatic implications of the verb, when the verb conflicts with other sources of information, it usually dominates. Children either respond with the protagonist which is appropriate for the verb or resolve the potential conflict by introducing a new entity. The verb seems to be a primary source of mapping between utterance and discourse from at least 5 years of age. The findings illustrate the flexible interaction of different sources of processing information and the importance of pragmatic inference even for the youngest children, and what seems to change developmentally is the balance between different sources of information. (MSE)

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Integration of information during language comprehension: A developmental study

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This research is about the processes involved in children's understanding of connected utterances. In particular, it asks the following question: What sources of information does a child use to integrate each new utterance into his or her representation of the prior discourse?

One way of exploring this issue is to look at how children use various types of anaphoric referring expressions. These devices offer a relatively transparent example of the general problem of mapping between utterance and discourse. Anaphoric devices can be clearly located in the local and global structure of a discourse, so that one can determine quite specifically what the listener has to do to make a successful link with the appropriate referent in the discourse model.

There are, in fact, few data on how children integrate a sequence of utterances into a coherent discourse by means of anaphoric referring expressions. Some recent research of my own suggests that by 5 years of age <u>some</u> anaphoric expressions - notably definite noun phrases - function effectively to locate the appropriate referent in the discourse representation (Tyler, 1983). However, other anaphoric expressions - pronouns in particular - continue to pose problems for children well after the age of 5 - whether they are producing language or comprehending it. In fact research on both the comprehension and production of pronouns suggests that their function within a discourse changes quite dramatically between the ages of 5-9 years.

Karmiloff-Smith's work (1980) on children's production of stories, for example, shows that until about 5 years of age, pronouns do not function to link utterances together. Rather, they are only used deictically to refer to extralinguistic entities. Pronouns do not appear to play an intralinguistic role until around 6 years of age, and even then it is a restricted role in which they only function as place-markers to maintain the thematic subject of the discourse.

My own work on the comprehension of anaphoric pronouns supports this general picture, and shows that during this second phase, when children encounter a pronoun it does not function referentially. Rather, its presence merely signals that the entity which is most prominent in the current discourse representation is continuing to be talked about. It is the structure of the discourse that places the strongest constraints on the integration of utterances into a coherent discourse.

This second phase is followed by a third phase in which children are

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sensitive to both the structure of the discourse and the lexical properties of the pronoun, such that both guide the integration of the incoming input with the existing discourse representation. Clearly, then, the relationship between discourse and pronoun with respect to the integration of utterances changes considerably between the ages of 5-8.

What is missing from this account, however, is the role of inferentially based constraints on pronoun resolution - constraints which are frequently based on the semantics of verbs. This type of constraint derives from the role of inference in determining whether the properties predicated of a pronoun in an utterance are pragmatically consistent with the properties assigned to the potential antecedents of this pronoun in the discourse model. Thus, in the sequence 'After saying goodbye to Bill, John came back into the room. He switched on the light', the resolution of the pronoun anaphor 'he' involves not only checking the number and gender of potential antecedents, but also whether the property subsequently predicated of the anaphor (i.e. switching on the light) is consistent with what is already known about potential antecedents (i.e. that John (and not Bill) has just entered the room).

Recent research (Marslen-Wilson, Tyler and Koster, 1984) suggests that, for adults, these processes of inferential assessment reflect the basic processes of pragmatically interpreting an utterance in its discourse context - even when the lexical information carried by the pronoun is, strictly speaking, sufficient to uniquely determine the correct referent.

Given the importance for adults of these pragmatic assessment procedures in developing a coherent discourse representation, what role do they play developmentally? What is their relationship to constraints imposed either by the lexical properties of pronouns or by the structure of the discourse?

To answer this question, I carried out an experiment which looked at the relative contribution of discourse constraints, subject anaphors, and the semantics of verbs to the integration of an utterance into its discourse representation. Children aged 5,7 and 10 years heard a series of short stories. Each story consisted of three complete sentences followed by an incomplete fragment. The first sentence introduced two major protagonists and the second and third established one of them as the discourse topic. The fragment had either an anaphoric pronoun or full nounphrase (referring to one or other of the two protagonists) in subject position followed by a verb (see example stories in the next section). Children had to continue the fragment with a few words. The dependent variable was which of the two protagonists they would chose as the object of the fragment, since this would reflect how they had integrated the fragment into the discourse representation.

There were three sources of constraint on their interpretation of the fragment - the discourse, the verb meaning and the form of the anaphor. All three either converged on a consistent interpretation of the fragment such that only one protagonist was appropriate as the object of the fragment, or they conflicted. The question was how children of different ages use these sources of information to guide

their interpretation of an utterance in its discourse context. When conflicts arise between them, how do children resolve them? Which sources do they rely upon and which do they ignore?

Predictions:

1. If there is a developmental phase during which the discourse structure (in the form of the 'thematic subject constraint') exerts the main constraint on the interpretation of new utterances, then this should be reflected in children's continuations. When the discourse comes into conflict with either the anaphor or the verb in the fragment, the discourse should dominate. That is, the child should assume that the discourse topic is the subject of the fragment and therefore produce the other protagonist as object.

2. Developmental changes in the referential function of anaphoric NPs and pronouns should result in differential effects. For younger children, NPs might over-ride discourse constraints (when they conflict) whereas pronouns should not. However, this difference should diminish with age. A similar pattern might emerge when the verb conflicts with NP or pronoun.

3. If there are developmental changes in children's ability to compute pragmatic inferences, with children improving with age, then there should be a phase when anaphor and discourse over-ride the potential constraints provided by the semantics of the verb. This should be followed at some point by the adult pattern in which the pragmatic implications of the verb are dominant.

Experimental details

Three types of story were used in the experiment. In Type 1, the discourse structure, and the semantics of the verb in the fragment converged on a consistent interpretation of the fragment - e.g. (all examples are translated form the Dutch originals):

1. The fireman looked up at the crying girl in the burning house. He quickly climbed up the ladder. He pulled open the window.
a) NP1 The fireman rescued...
b) PRO1 He rescued...
c) NP2 The girl rescued...
d) PRO2 She rescued...

In this case, the constraints imposed by both the discourse and the semantics of the verb require the fireman to be subject, so that the girl should be produced as object of the fragment. This preference is consistent with the subject NP and pronoun in conditions (a) and (b), but not in (c) and (d).

In Type 2 stories, the discourse biassed towards one protagonist as the object of the fragment but the verb was neutral - e.g.

2. The clown walked up to the blond girl sitting in the front row. His suit was much too big. He also had big floppy shoes on.
a) NP1 The clown laughed at...
b) PRO1 He laughed at...
c) NP2 The girl laughed at...
d) PRO2 She laughed at...

Here NP1 and PRO1 are consistent with the discourse bias, both leading to the production of the girl as the object of the verb, whereas in conditions (c) and (d) the discourse biar and the anaphors conflict.

In Type 3 stories, the discourse biased towards one protagonist as subject while the verb was inconsistent with this - e.g.

3. Naughty Stephen pesters his teacher, Miss Jones. He doesn't want to do arithmetic. He'd much rather be outside.
a) NP1 Stephen punishes...
b) PRO1 He punishes...
c) NP2 Miss Jones punishes...
d) PRO2 She punishes...

In conditions (a) and (b) the discourse and the subject anaphor bias towards the same object (Miss Jones), whereas the verb in the fragment biases towards Stephen. In conditions (c) and (d), however, only the discourse biases towards Miss Jones as the preferred continuation, and both the subject anaphors and the verb bias towards Stephen.

16 stories of each of these three types were constructred, making a total of 48 stories. There were four versions of each story - each with a different type of subject in utterance-initial position (NP1, NP2, PRO1, PRO2). A child only heard one version of each story. 40 children of 5,7 and 10 years were tested, with 10 children per version. The children had to listen to the story and continue the final fragment with one or two words.

Responses were scored in the following way: First, according to whether either of the two major protagonists was chosen as the object of the fragment. If so, whether the protagonist was referred to by a definite NP or pronoun. If neither main protagonist was mentioned, responses were categorised as either semantically appropriate or inappropriate continuations, and I also noted whether a new entity or some other entity from the discourse was mentioned. Sometimes children changed the subject of the fragment to the other main protagonist in the story and this was also noted. I also recorded when children failed to make any response at all.

Results

1. Type 1 stories:
In these stories, both the discourse and the verb bias towards NP2 as the response. The percentage of repsonses in which children chose one or other of the main protagonists as object are shown in Table 1.

Table 1

Subject type	Response type	Percentage responses Age 5yrs	7yrs	10yrs
NP1	NP1/PRO1	2	1	0
	NP2/PRO2	88	86	95
PRO1	NP1/PRO1	1	2	6
	NP2/PRO2	88	90	87
NP2	NP1/PRO1	50	49	28
	NP2/PRO2	9	8	2
PRO2	NP1/PRO1	11	18	18
	NP2/PRO2	58	52	14

a) When the discourse, verb and anaphor (whether NP or pronoun) are consistent with the same interpretation, children of all ages interpret the fragment correctly.

b) When the discourse and verb prefer one protagonist as the object of the fragment and this is inconsistent with the subject NP, the NP exerts the most control, and children tend to produce an object which is compatible with the subject NP. However, children clearly do not ignore the other sources of information since the percentage of responses compatible with the NP drops from between 86-95% when the discourse and verb are consistent with the NP, to between 28-50% when they are not. When they encounter this type of conflict, children (especially the older ones) tend to change the subject NP to make their continuation compatible with the other sources of information.

c) In contrast, when the subject pronoun conflicts with the discourse and the verb, the pronoun does not control responses. There are also clear developmental changes here. The 5 and 7 year olds' continuations are constrained by the discourse and verb, whereas the older child will not tolerate the conflict and so change the subject of the fragment (64% of the time).

In summary, an anaphoric pronoun in subject position, when it does not refer to the thematic subject (PRO2), is less dominant than either

the subject NP or the discourse and verb together in directing the mapping between utterance and discourse. This is especially true for the younger children.

2. Type 2 stories:
Here the discourse biases towards NP2 as a response and the verb is neutral. The results are shown in Table 2.

Table 2

Subject type	Response type	Percentage responses Age 5yrs	7yrs	10yrs
NP1	NP1/PRO1	2	1	1
	NP2/PRO2	79	85	93
PRO1	NP1/PRO1	3	3	2
	NP2/PRO2	83	84	91
NP2	NP1/PRO1	87	93	94
	NP2/PRO2	3	1	0
PRO2	NP1/PRO1	57	74	84
	NP2/PRO2	27	15	5

a) Once again, when all sources of information are consistent, children interpret the fragment correctly - whether the subject of the fragment is NP or pronoun.

b) When the subject anaphor and the discourse conflict, the subject dominates - but it is more dominant when marked with an NP than a pronoun. There are developmental differences here, with pronouns being less effective for the younger children.

c) When children do not continue the fragment with either protagonist, they introduce new entities.

3. Type 3 stories:
In this set we can see whether the discourse or the verb is dominant when they are pitted against each other, and when the subject is consistent with or in conflict with either one. The discourse biases towards NP2 as the continuation of the fragment, whereas the verb biases towards NP1. The results are shown in Table 3.

Table 3

Subject type	Response type	Percentage responses Age 5yrs	7yrs	10yrs
NP1	NP1/PRO1	25	19	7
	NP2/PRO2	28	37	21
PRO1	NP1/PRO1	22	22	7
	NP2/PRO2	35	29	14
NP2	NP1/PRO1	93	96	99
	NP2/PRO2	0	1	1
PRO2	NP1/PRO1	77	89	95
	NP2/PRO2	12	4	1

a) The verb and the subject NP or pronoun together clearly over-ride the discourse. For 5 year olds, the pronoun is slightly less effective than for older children (77% as opposed to 89% and 95%).

b) There is a slight advantage for NP or pronoun when it conflicts with the verb. We know that this advantage is due to the NP and pronoun rather than the discourse because in Type 2 stories, when the NP or pronoun conflicted with the discourse (and the verb was neutral), discourse constraints were ignored in favour of the subject. In general, though, when the subject (whether NP or pronoun) and the verb conflict, about half the time children do not respond with one of the main protagonists. They either introduce a new entity or correct the fragment.

In summary, when the discourse and the verb are pitted against each other so that the subject anaphor is consistent with only one of them, children base their interpretation on whichever two sources of information are consistent. But the verb is clearly dominant over the discourse.

General Discussion

We can draw two main conclusions from these data. First, the thematic subject constraint (TSC) is not as dominant for the youngest children as one might have expected it to be on the basis of earlier research (e.g. Karmiloff-Smith, 1980; Tyler, 1983). This is supported by three aspects of the data. First, if the TSC is dominant, responses should be guided by the discourse, irrespective of whether or not the pronoun is consistent with it. However, this is not what happens. Instead, when discourse and pronoun conflict, responses compatible with the discourse drop from 88% to 58%. Similarly, in Type 2 stories, whether PRO1 or PRO2 is in subject position should not affect responses, but it does - 57% of responses

are compatible with PRO2 even though it conflicts with the discourse. Finally, in Type 3 stories, the discourse is strongly over-ridden when the verb is consistent with the pronoun. Here 57% of responses are compatible with the pronoun (and incompatible with the discourse) and only 27% are compatible with the discourse and incompatible with the pronoun.

So, for the younger children (5 and 7 year olds in this study), the TSC is not totally dominant. Mapping the utterance onto the discourse representation is not achieved simply by maintenance of the thematic subject via a pronoun which, in itself, has no referential function. Rather, the lexical properties of pronouns are taken into account by young children when mapping between utterance and discourse - although not to the same extent as for older children (and adults - see, Marslen-Wilson, Tyler & Koster, 1984).

The second general point concerns the importance of evaluating protagonists with respect to the pragmatic implications of the verb. When the verb conflicts with other sources of information, it is usually dominant. Children either respond with the protagonist which is appropriate for the verb, or they resolve potential conflict by introducing a new entity. The pragmatic constraints imposed by the verb cannot be over-ridden in the same way as discourse constraints. It thus seems to be a primary source of mapping between utterance and discourse. From at least the age of 5 years, children's integration of utterance and discourse is primarily guided by considerations of pragmatic plausibility generated by the verb.

This - and other research on children and adults - suggests the following picture of processes involved in mapping an utterance onto its discourse context. First, the listener's mental representation of the discourse is organised so that certain mental knowledge structures - corresponding to potential discourse antecedents - will be preferentially accessible for the processing of a subsequent utterance. When a new utterance begins, all potential antecedents will be evaluated in parallel for their compatibility with the different types of information provided by the new utterance. This process will continue until a coherent discourse representation can be established between the utterance and its context.

Within this framework, the lexical information carried by pronouns doesn't funtion in all-or-none fashion to pre-select candidate antecedents. Instead, the pronoun contributes just one of several inputs to the evaluation process, whose outcome can not be satisfied just by the information carried by the pronoun alone. Pragmatic inference, however, plays a central role - as the results here show. The resolution of discourse reference critically depends upon establishing pragmatic coherence between antecedent and utterance.

The present data illustrate this flexible interaction of different sources of processing information - and the importance of pragmatic inference - even for the youngest children. What seems to change developmentally is the balance between different sources of information. The pronoun, although functioning referentially, is less important for younger children than for older children and adults.

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